CLAIMS

1. A mechanism including:

a piston-and-cylinder assembly including a piston housed in a cylinder,

a pin member passing through the piston and

a guide member having a guide recess accommodating an end of the pin member,

the guide recess being so shaped and orientated in relation to the piston-and-cylinder assembly that a common axis exists between the guide recess and the piston-and-cylinder assembly,

the guide member and the piston-and-cylinder assembly being so mounted as to be rotatable relative to each other about the common axis and

the guide recess being a figure-8 in shape bounded by an outer and an inner periphery, for guiding the pin member continuously in a figure-8 path, causing the piston to sweep up and down the cylinder, when the guide member and the piston-and-cylinder assembly rotate relative to each other,

the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke being smaller than the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes, of the operating cycle.

2. A mechanism including:

a piston-and-cylinder assembly including a first piston housed in a first cylinder and a second piston housed in a second cylinder,

a first pin member passing through the first piston and a second pin member passing through the second piston and

a guide member having a guide recess accommodating an end of the first pin member and an end of the second pin member,

the guide recess being so shaped and orientated in relation to the piston-and-cylinder assembly that a common axis exists between the guide recess and the piston-and-cylinder assembly,

the guide member and the piston-and-cylinder assembly being so mounted as to be rotatable relative to each other about the common axis and

the guide recess being a figure-8 in shape bounded by an outer and an inner periphery, for guiding the pin members continuously in a figure-8 path, causing the piston to sweep up and down the cylinder, when the guide member and the piston-and-cylinder assembly rotate relative to each other,

the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke being smaller than the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes, of the operating cycle.

3. A mechanism as claimed in claim 2, wherein the form of the piston-and-cylinder assembly permits the first and second cylinders to lie diametrically opposed to each other.

4. A mechanism as claimed in claim 2, including a further cylinder, a further piston in the further cylinder and a further pin member passing through the further piston and being accommodated in the guide recess, the first, second and further cylinders being spaced 120° apart.

5. A mechanism as claimed in claim 3, including at least one further pair of diametrically opposed cylinders on the piston-and-cylinder assembly,

further pistons in the further cylinders and

further pin members passing through the pistons and being accommodated in the guide recess.

6. A mechanism as claimed in claim any one of claims 1 to 5, wherein the ratio of the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke to the radius of the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes lies in the range from about 0.95 to about 0.01, both limits included.

7. A mechanism as claimed in any one of claims 1 to 6, wherein the ratio of the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke to the radius of the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes lies in the range from about 0.85 to about 0.15, both limits included.

8. A mechanism as claimed in any one of claims 1 to 7, wherein the ratio of the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke to the radius of the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes lies in the range from about 0.75 to about 0.25, both limits included.

9. A mechanism as claimed in any one of claims 1 to 8, wherein the ratio of the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke to the radius of the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes lies in the range from about 0.65 to about 0.35, both limits included.

10. A mechanism as claimed in any one of claims 1 to 9, wherein the ratio of the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke to the radius of the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes lies in the range from about 0.55 to about 0.45, both limits included.

11. A mechanism as claimed in any one of claims 1 to 10, wherein the radius of curvature of the section of the outer periphery of the guide recess determining piston movement

during the induction stroke is of the order of a half of the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes.

12. A mechanism as claimed in any one of claims 1 to 8, wherein the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke is of the order of two-thirds of the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes.

13. A mechanism as claimed in any one of claims 1 to 8, wherein the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke is of the order of between two-thirds and a half of the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes.

14. A mechanism as claimed in any one of claims 1 to 13, including a second guide member having a second guide recess accommodating the other end of the pin member or the other ends of the pin members, the second guide recess being so shaped and orientated in relation to the piston-and-cylinder assembly as to share the common axis existing between the first guide recess and the piston-and-cylinder assembly, the second guide recess being of the same form as the first guide recess.

15. A mechanism as claimed in any one of claims 1 to 14, including axial slots in the cylinder or the cylinders, the pin member or pin members engaging the axial slots, to serve as guide means to the piston or pistons.

16. A mechanism as claimed in claim 15, wherein the axial slots lie on a diameter of the cylinder or cylinders.

17. A mechanism as claimed in any one of claims 1 to 16, including guide means for the piston or pistons so positioned as to engage the piston shank or piston shanks.

18. A mechanism as claimed in claim 17, wherein the or each piston shank includes a rectangular portion and the guide means is of complementary shape and engages the rectangular portion of the or each piston shank.

19. A mechanism as claimed in claim 18, wherein the or each piston shank includes an H-form transverse cross-section portion.

20. A mechanism as claimed in claim 18 or claim 19, wherein the or each piston shank includes an H-form transverse cross-section portion and the horizontal element of the H projects beyond both of the vertical elements of the H.

21. A mechanism as claimed in any one of claims 1 to 20, wherein common axis is the axis of a shaft on which the piston-and-cylinder assembly is rotatably mounted, the remainder of the mechanism being fixed.

22. A mechanism as claimed in any one of claims 1 to 20, wherein the common axis is the axis of a shaft on which the guide member is rotatably mounted or the guide members are rotatably mounted, the piston-and-cylinder assembly being fixed.

23. A mechanism as claimed in any one of claims 1 to 20, wherein the common axis is the axis of a shaft on which the guide member is or the guide members are rotatably mounted and the piston-and-cylinder assembly is rotatably mounted on the shaft.

24. A mechanism as claimed in any one of claims 1 to 23, including bearing means at the end of the pin member or the ends of pin members accommodated in the guide recess, for effecting rolling contact between the peripheries of the guide recess and the end of the pin member or the ends of the pin members.

25. A mechanism as claimed in claim 24, wherein the bearing means at the end of the pin member or the ends of the pin members includes an outer bearing assembly contacting only the outer periphery of a guide recess and an inner bearing assembly contacting only the inner periphery of the guide recess.

26. A mechanism as claimed in claim 25, wherein the outer bearing assembly includes an outer cylindrical shell supported by a plurality of outer rollers on the pin member, the outer cylindrical shell lying in contact with the outer periphery only of the guide recess.

27. A mechanism as claimed in claim 26 or claim 26, wherein the inner bearing assembly includes an inner cylindrical shell supported by a plurality of inner rollers on the pin member, the inner cylindrical shell lying in contact with the inner periphery only of the guide recess.

28. A mechanism as claimed in claim 26 or claim 27, wherein the outer and inner bearing assemblies are so mounted that the outer and inner cylindrical shells rotate about the same axis.

29. A mechanism as claimed in any one of claims 26 to 28, wherein the outer and inner bearing assemblies are so mounted that the outer and inner cylindrical shells rotate about the axis of the pin member.

30. A mechanism as claimed in claim 26 or claim 27, wherein the outer and inner bearing assemblies are so mounted that the outer cylindrical shell rotates about an axis which is offset from the axis about which the inner cylindrical shell rotates.

31. A mechanism as claimed in any one of claims 26 to 29, wherein the bearing means includes a ball bearing between the outer and inner bearing assemblies, the balls of the ball bearing running in tracks in the outer and inner cylindrical shells.

32. A mechanism as claimed in any one of claims 1 to 31, including a guide recess having an inner periphery including a step in its profile for accommodating bearing means at the end of the pin member or the ends of the pin members, the bearing means including an outer bearing

assembly contacting only the outer periphery of a guide recess and an inner bearing assembly contacting only the inner periphery of the guide recess.

33. A mechanism as claimed in any one of claims 1 to 32, including a guide recess having an outer periphery the surface of which is narrower than the surface of the inner periphery, bearing means at the end of the pin member or the ends of the pin members including an outer bearing assembly contacting only the narrower surface of the outer periphery of a guide recess and an inner bearing assembly contacting only the surface of the inner periphery of the guide recess.

34. A mechanism as claimed in any one of claims 1 to 33, wherein a plurality of apertures are included in the pin member or pin members for receiving and distributing lubricant to the end of the pin member or pin members.

35. A mechanism as claimed in claim 34, including a guide member having at least one aperture so positioned as to permit the delivery of lubricant through the guide member to the pin member or pin members.

36. A mechanism including:

a piston-and-cylinder assembly including a piston housed in a cylinder,

a pin member passing through the piston and

a guide member having a guide recess accommodating an end of the pin member,

the guide recess being so shaped and orientated in relation to the piston-and-cylinder assembly that a common

axis exists between the guide recess and the piston-and-cylinder assembly,

the guide member and the piston-and-cylinder assembly being so mounted as to be rotatable relative to each other about the common axis and

the guide recess being a figure-8 in shape bounded by an outer and an inner periphery, for guiding the pin member continuously in a figure-8 path, causing the piston to sweep up and down the cylinder, when the guide member and the piston-and-cylinder assembly rotate relative to each other,

the guide recess having an inner periphery including a step in its profile accommodating bearing means at the end of the pin member or the ends of the pin members, the bearing means including an outer bearing assembly contacting only the outer periphery of a guide recess and an inner bearing assembly contacting only the inner periphery of the guide recess.

37. A mechanism as claimed in claim 36, including a guide recess having an outer periphery the surface of which is narrower than the surface of the inner periphery, bearing means at the end of the pin member or the ends of the pin members including an outer bearing assembly contacting only the narrower surface of the outer periphery of a guide recess and an inner bearing assembly contacting only the surface of the inner periphery of the guide recess.

38. A guide member, for a piston-and cylinder assembly, having a guide recess accommodating an end of a pin member passing through a piston of the piston-and-cylinder assembly,

the guide recess being a figure-8 in shape bounded by an outer and an inner periphery, for guiding the pin member continuously in a figure-8 path,

the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke being smaller than the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes, of the operating cycle.

39. A guide member as claimed in claim 38, wherein the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke is of the order of a half of the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes.

40. A guide member as claimed in claim 39, wherein the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke is of the order of two-thirds of the radius of curvature of the sections of the inner periphery of the guide recess determining piston movement during the compression, expansion and exhaust strokes.

41. A guide member as claimed in claim 39, wherein the radius of curvature of the section of the outer periphery of the guide recess determining piston movement during the induction stroke is of the order of between two-thirds and a half of the radius of curvature of the sections of the inner periphery of the guide recess determining piston

movement during the compression, expansion and exhaust strokes.

42. A heat engine including a mechanism as claimed in any one of claims 1 to 41, wherein the pistons and cylinders are pistons and cylinders of the heat engine and, in operation, generate motive power for the mechanism.

43. A heat engine as claimed in claim 42, which is an internal combustion engine.

44. An engine as claimed in claim 42 or claim 43, which is a Diesel-cycle engine.

45. An engine as claimed in claim 42 or claim 43, which is an Otto-cycle engine.

46. An engine as claimed in claimed in any one of claims 42 to 45, which is a four-stroke engine.

47. An engine as claimed in any one of claims 42 to 45, which is a two-stroke engine.